the illness of his mother, he therefore must cooperate with others by correspondence. Not long ago he wrote out an interesting lecture on snow crystals and sent it with many lantern slides to a friend at the Brooklyn Institute of Arts and Sciences, where the lecture was delivered with great success. This suggests that other instructors, lecturers, lyceums, etc., may also secure material for an interesting lecture on a new topic and thus interest the public in meteorological matters. We hope that the State superintendents of schools will take this matter up officially as a proper branch of nature study in school work.

PHYSICAL SOCIETIES AND JOURNALS.

Many of the readers of the MONTHLY WEATHER REVIEW are deeply interested in those branches of the study of mathematics and physics that bear on meteorology, and desire to keep in close touch with the progress of our knowledge along these lines. This can be best accomplished by becoming an associate member of either the American Physical Society, the American Mathematical Society, or the Astrophysical Society. The first named offers special advantages, since its members receive Science Abstracts and the Physical Review regularly. These monthly periodicals bring to one's attention much of what is new in physical science. Those who wish further details should correspond with the Editor, or with the secretary of the American Physical Society, Prof. Ernest Merritt, Cornell University, Ithaca, N. Y.

A journal of scientific news is as essential to the student as a daily paper is to the business man. It would be convenient if all meteorological matters were published in one journal, but this has never yet been done, and one must read several in order to compass the field. The more important periodicals are the following:

IN ENGLISH.

American Journal of Science, New Haven.
Astrophysical Journal, Chicago.
Proceedings of the Royal Society, London.
Quarterly Journal of the Royal Meteorological Society, London.
Science, New York.
Symons's Meteorological Magazine, London.
Science Abstracts, London.
London, Edinburgh, and Dublin Philosophical Magazine.
Scottish Meteorological Magazine, Edinburgh.
Terrestrial Magnetism and Atmospheric Electricity, Baltimore.
Nature, London.
Physical Review, Lancaster.

IN FRENCH.

Annuaire de la Société Météorologique de France, Paris.
Archives des Sciences Physiques et Naturelles, Genève.
Bulletin de la Société Belge d'Astronomie, Bruxelles.
Comptes Rendus de l'Académie des Sciences, Paris.

IN GERMAN.

Annalen der Hydrographie und Maritimen Meteorologie, Berlin.
Physikalische Zeitschrift, Leipzig.
Gaea, Leipzig.
Das Wetter, Berlin.
Meteorologische Zeitschrift, Wien.
Naturwissenschaftliche Rundschau, Berlin.
Annalen der Physik, Leipzig.

COLD AND HEAT.

The following inquiry, which seems to be going the round of the press in the West, has been forwarded to the Chief of the Weather Bureau with a request for an authoritative answer:

"How cold is it when it is twice as cold as two degrees above zero (Fahrenheit)?"

The expression "twice as cold" has no definite meaning and is not used in scientific language nor in rational popular English. We simply say "warmer" for more heat and "colder" for less heat.

It is customary to measure the condition of bodies only with respect to heat, not cold. The scale by which the relative hotness of bodies is measured is the scale of temperature, the starting point of which is the temperature at which the molecular vibrations that constitute heat cease. This point is called the absolute zero of temperature. The absolute zero of temperature is 459° below zero (—459°) on the Fahrenheit scale, at which temperature a body has no heat and is said to be at 0° on the absolute scale of temperature.

A body at +2° F. may therefore be said to have 461 Fahrenheit degrees of temperature on the absolute scale. "Twice as cold" might be considered to mean one-half as hot. If so, then anything that is twice as cold as something at 2° F. must have one-half of 461 degrees of temperature, or 230.5 degrees. The temperature on the Fahrenheit scale of a body having 230.5 degrees of temperature on the absolute scale is $-459° + 230.5° = -228.5°$, or 228.5° below zero Fahrenheit.

It is not possible to say anything more definite than this, as the expression "twice as cold" can have no real significance until a scale for measuring cold has been adopted. Heat is measured upward from the absolute zero of heat, but cold must be measured downward from some arbitrary point that has never yet been defined.

METEORS: THEIR INCANDESCENCE AND THEIR NOISE.

In Nature for October 19, 1905, Mr. George A. Brown suggests that the incandescence of shooting stars has an electrical origin, or that the heat evolved is due to the passage of the meteor across the lines of force in the earth's magnetic field. To this Prof. A. S. Herschel replies that although such induced electric currents must exist, yet the heating effect must be extremely small and incomparably subordinate to the heat evolved by the adiabatic compression of the air against the front surface of the meteor. He calculates that—

> If the kinetic energy of translation in foot pounds of one pound of air at the meteor's velocity be divided by 330, the number thus obtained, 1,180,620, will be the number of centigrade degrees through which the air will be heated by the pure process of compression. This relates to the air in immediate contact with the front of the meteor, and lower temperatures would prevail in the layers outside of that.

He thinks that the induced electric and magnetic phenomena are unimportant for both the stony and the metallic meteors as compared with these enormous thermal effects, but he seems to suggest that electricity may explain the long enduring bright streaks left along the paths of all the brighter shooting stars and larger meteors.

The compression of the air in front of the meteor takes place so rapidly, owing to the great speed of the meteorite, that the gas has no time to dissipate in front or to spread out on all sides. It is compressed and intensely heated by the impact, but remains a perfect, frictionless, elastic fluid. Within this small mass of heated air the speeds of the sound waves differ from the speed of flow of air itself in proportions or ratios that diminish asymptotically toward the ultimate ratio $\frac{1}{\sqrt{5}}$. Within this mass of hot air are sound waves conveying the strokes and shocks of the collisions to and fro between the meteor's center and the surrounding quiet air. Such sounds begin, travel, and end within the moving field of heated, compressed air as if it were at rest, although really fresh particles of air are continually entering the field with new collisions and starting new waves of sound while the older particles and their waves fall away.

By these extremely rapid actions and in an exceptionally perfect elastic fluid a steady relation or steady disposition of the lines or lanes of air flow and blast pressure must really be established and maintained in evenly persistent shapes and contours within the swirl of incandescent air which forms the meteor's head.

As every meteorite shows a thin surface layer of its own material to have been heated, burned, pushed, scraped, or dragged off as by the flow of some blast of hot air, we must add this small mass of meteoritic dust, this heated, incandescent, vaporized, and burning solid, to the incandescent gas that constitutes the meteor trail. This incandescent dust is a new chemical compound of meteoritic matter and atmospheric gases and is left behind as a long, comparatively straight, luminous streak. Observers have watched such streaks for many minutes, and the changes in their apparent shapes do not seem to us to require any assumption of electric or magnetic action for their explanation. A long streak of isolated particles of iron rust does not constitute a magnet, nor could it show any magnetic phenomena under magnetic influence, excepting such as are revealed by individual positively and negatively electrified ions in a perfect vacuum, such as have been revealed to us by the well-known studies of J. J. Thomson. That the streaks do not show such phenomena demonstrates the absence or feebleness of the magnetic and electric fluids in the upper atmosphere of our earth.

It seems to the Editor that the noises that emanate from the meteors are still as difficult of explanation as ever. Professor Herschel's exposition brings vividly before us the waves of sound that are being interchanged between the mass of the meteor and that of the compressed air in its neighborhood, but how can these sound waves reach the ear of an observer through the rarefied atmosphere that exists at a very short distance from the meteor. This atmosphere is so thin or so rare that not only are ordinary sound waves not observable through it, but, according to our present theory of sound, could not even exist therein. Meteors that are 50 miles above the earth's surface and moving nearly horizontally give out sounds that are heard like the discharge of a nearby cannon, although the observer is 150 miles away. This has been notably the case with several that have been investigated in the United States. At these great elevations the gaseous pressure of the atmosphere, that is to say, the elastic pressure which follows the law of Boyle and Mariotte, no longer exists. The individual particles are so far apart that, according to the kinetic theory of gases, the collisions among the particles are infrequent. A meteor rushing among these at the usual meteoric rate of 20 miles per second strikes the individual particles and drives them forward far more frequently than they strike each other; they would, in fact, be entirely submissive to its influence, and, after escaping therefrom, they would find no surrounding atmosphere capable of transmitting sound waves downward to the denser atmosphere near the earth's surface. The sound waves observed in connection with meteors are always described as resembling the booming of an irregular discharge of artillery, rumbling like thunder, coming first from a point on the track of the meteor nearly opposite to the observer, but then from points successively farther back on the preceding parts of the track. It is never heard from points on the subsequent parts of the track. The physical explanation of this phenomenon has been attempted by many, but we know of nothing sufficiently satisfactory to be worth repeating. The rolling of thunder takes place in an analogous manner, but that relates to the lower, denser atmosphere. In our report on the meteor of December 24, 1873, we showed that, if the whole meteor track nearest and opposite the observer be considered as a straight line every point of which became instantaneously the source of sound, then the observer should hear first a crash and subsequently the roaring noises from the more distant preceding and succeeding portions of the line. But why should it always roll backward, and how can any sound at all pass from the thin upper air down to the earth? It does not do to say with Professor Mach and others that every stroke of the meteor against an atom of air is a collision and that a myriad such strokes will make a noise, for this only explains the vibrations within the mass of the meteor and within the volume of compressed air attending it; it does not explain the passage of such sounds to the observer through the "Crookes vacuum" of the upper air.

METEOROLOGICAL LITERATURE IN THE PUBLIC LIBRARIES.

In connection with a lecture on "Storms," delivered by Mr. John R. Weeks, official in charge of the local office of the Weather Bureau at Binghamton, N. Y., a local newspaper, the Press Leader, published a list of the books on meteorology procurable at the Public Library, in order that those who wished to prepare for the lecture, and those with a desire to go further into the subject, might be guided to the proper sources of information.

This practice is commended to other Weather Bureau lecturers as being a means of increasing the interest of the public in the subject of meteorology. It will also stimulate the librarians to provide the necessary books when called for.

The Librarian of the Weather Bureau has compiled and published a list of books for use in studying meteorology, which will no doubt prove valuable to Weather Bureau officials and others who are called upon to select or advise in the selection of authoritative books on meteorology.—*E. R. M.*

STANDARD TIME AT KEY WEST.

On November 16, 1905, the board of aldermen of the city of Key West, Fla., decided to change the standard of time in local use from ninetieth meridian time to seventy-fifth meridian time, the change to be effected by omitting the hour between 11 a. m. and noon on Thursday, November 23, 1905. This action was taken "in order that the time on the city clocks might be the same as that of the naval station, the telegraph office, and the ships calling there."

In order to comply with the provision of Weather Bureau Instructions No. 210, of 1904, dated December 16, 1904, which requires that "all instrumental records and the daily local record shall be kept on local standard time," it has been directed that seventy-fifth meridian time be used as station time at the local office of the Weather Bureau at Key West, Fla., beginning immediately after 12 midnight of December 31, 1905.

Those who have occasion to consult the original records above mentioned should bear in mind that they have been prepared on ninetieth meridian time during the year 1905.

INFLUENCE OF LOCATION ON THE WINDS.

An article on the influence of orography on the winds at Quebec, by Monsignor J. C. K. Laflamme, professor of geology, etc., at Laval University in that city, brings out strongly the fact that the winds recorded at this meteorological station are controlled almost entirely by the configuration of the neighboring ground, and this too, to an extent that would hardly have been expected, notwithstanding the fact that the broad valley of the St. Lawrence has a general trend that coincides with the prevailing general movement of the atmosphere. The memoir is published in tome 10, of the second series of the Memoires de la Société Royale du Canada.